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REPORT OF WATER QUALITY SURVEY OF
MISSISSIPPI RIVER FROM CLINTON, IOWA,
TO ROCK ISLAND, ILLINOIS

Philip J. Coffey, et al

Sanitary Engineering Center
Cincinnati, Ohio

February 1962

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REPORT OF WATER QUALITY SURVEY OF MISSISSIPPI RIVER
FROM CLINTON, IOWA, TO ROCK ISLAND, ILLINOIS

By

Philip J. Coffey
Senior Sanitary Engineer
Field Operations Section
Cincinnati, Ohio

and

John M. Rademacher
Senior Sanitary Engineer
Region V - Chicago, Illinois

U. S. Department of Health, Education, and Welfare
Public Health Service
Bureau of State Services

Public Health Service Sanitary Engineering Center
Cincinnati, Ohio

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City of Moline, Water Department
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Field and laboratory work was done in cooperation with a staff assigned from the Public Health Service Sanitary Engineering Center, Cincinnati, Ohio, and the Regional Programs for Water Supply and Pollution Control, Chicago and Kansas City. The survey was conducted under the general supervision of F. W. Kittrell, Engineer in Charge, Water Pollution Evaluation, of the Public Health Service Sanitary Engineering Center.

INTRODUCTION

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The Mississippi River reach below Clinton, Iowa, has a history of reported pollution extending back to 1943 (see Appendix A). Following a detailed study by the State of Iowa, Department of Public Health, in 1952, a report⁽¹⁾ was prepared by that agency in July 1954 and distributed to eleven public and private corporations which were discharging untreated wastes into the Mississippi River and its tributaries near Clinton, namely:

City of Clinton

Clinton Wire Cloth Company

The Pillsbury Mills, Inc.

Curtis Companies, Inc.

Climax Engine and Pump Company

Clinton Foods, Inc. (now Clinton Corn Processing Company)

Swift and Company

Interstate Power Company

The Collis Company

Town of Camanche

E. I. duPont de Nemours and Company, Inc.

(1) "Report on the Water Pollution Investigation of the Mississippi River and Its Tributaries in and Below Clinton, Iowa, July 1954."

Recommendations for reduction of river pollution were made, comprising in the cases of the two public corporations a minimum of "effective sedimentation, substantially complete removal of floatable solids and liquids, and reduction of toxic materials to less than lethal limits for aquatic life." A similar recommendation was made in respect to the private industrial corporation, with the option of making provision to connect to a municipal sewerage system where feasible. These recommendations were confirmed in a public hearing conducted by the State of Iowa, Department of Public Health, on December 16, 1954. Progress in abatement of pollution having been determined in most instances unsatisfactory, the State of Iowa convened a second hearing October 26, 1961, in which the Cities of Clinton and Camanche and six industrial firms in the area were cited for pollution of the Mississippi River.

The present study by the Public Health Service, U. S. Department of Health, Education, and Welfare, was carried out under authority of Section 8(c) of the Federal Water Pollution Control Act as amended (87th Congress), in cooperation with the Public Health Service Programs of Regions V and VI, and of the Field Operations Section of the Public Health Service Sanitary Engineering Center. *the report includes*
A field survey of water quality was conducted between October 23 and 31, 1961, in the 40-mile reach of the Mississippi from Dam 13 to Dam 15, with particular reference to bacterial concentrations, dissolved oxygen content, and biological indicators of pollution. Stream flows and laboratory data are tabulated in Appendix B.

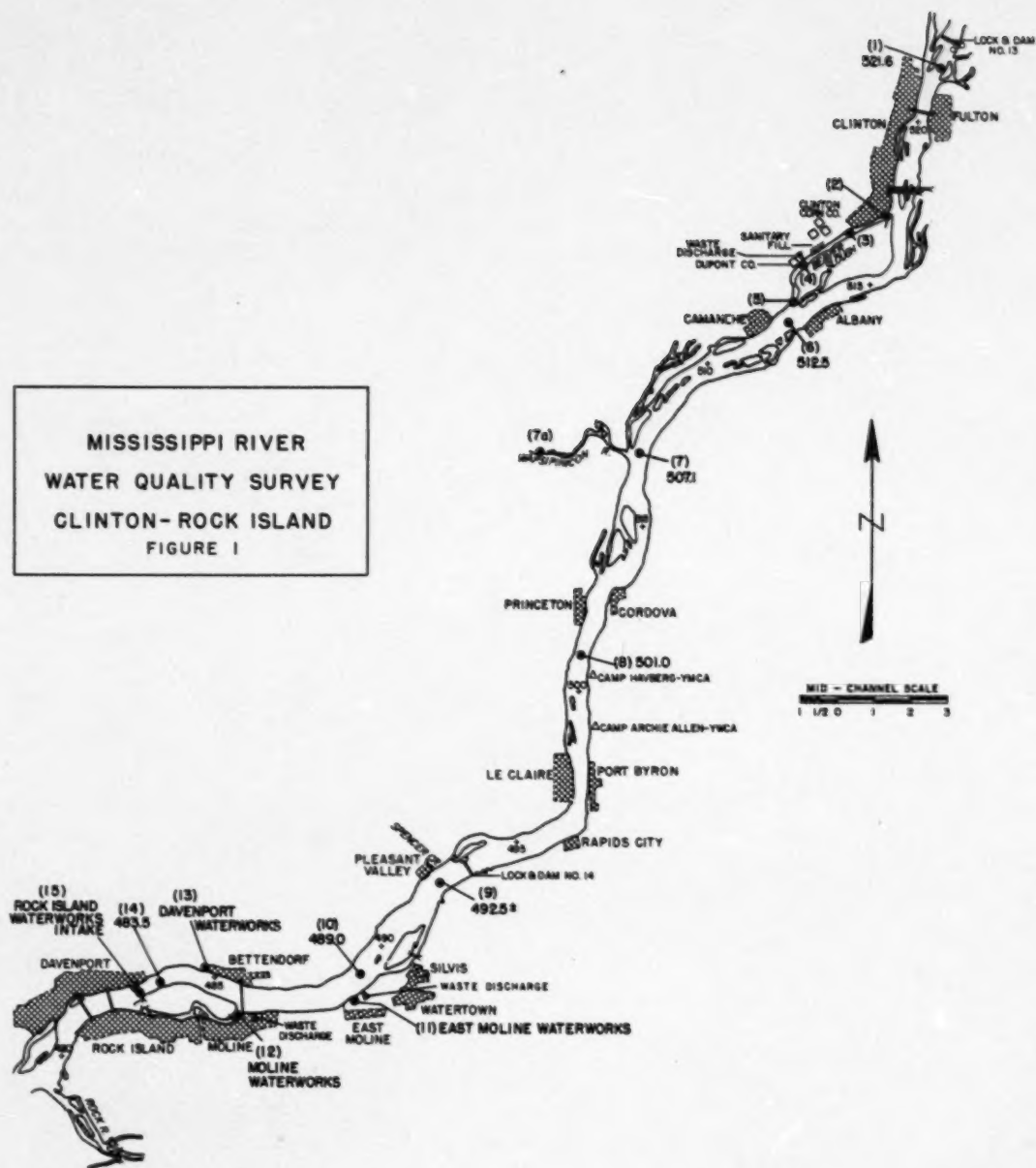
Samples for dissolved oxygen and coliform bacteria tests were collected daily, weather permitting, at seven sections on the mainstem of the Mississippi, on the Wapsipinicon River at Iowa State Highway 67, and at four points along Beaver Slough, a subsidiary channel just downstream from Clinton, on the Iowa side of the river. At each of the seven sections of the mainstem, samples were taken approximately at the three quarter-points of the channel. Beaver Slough is of interest as the receiving water body for important industrial waste discharges from Clinton Corn Processing Company and the du Pont cellophane plant. In addition daily samples were collected for bacterial examination near the river intakes of four major water treatment plants, namely those supplying the Cities of East Moline, Moline, Davenport-Bettendorf, and Rock Island. The sampling stations are listed and briefly described in Appendix C.

THE AREA

The principal river reaches involved are the pools formed by Dams 14 and 15 on the Mississippi River for a total river length of 39 miles. Figure 1 shows locations of sampling stations.

There are 16 communities which have direct frontage on this river stretch. Nine of them are in Illinois and seven in Iowa. Thirteen of the sixteen have some form of sewerage system. The Illinois group has a total urban population of 118,396, and the Iowa towns a combined urban population of 138,955, or a total urban river front population of 257,351. The county populations which have nominal access to the river total 274,127 for Scott and Clinton Counties

MISSISSIPPI RIVER
WATER QUALITY SURVEY
CLINTON - ROCK ISLAND
FIGURE 1



in Iowa, and 210,878 for Whiteside and Rock Island Counties in Illinois, or a combined total of 485,005.*

Ten industries also use the river for waste water disposal. Of these, seven are in the Clinton-Camanche, Iowa, area, two are on the northern edge of Bettendorf, Iowa, and one is in East Moline, Illinois. The industries reflect a wide diversity of operations although the agriculture influence of the regional economy is paramount. Corn and soybeans serve as raw materials for major processing operations in the Clinton area. Metal fabrication for the very concentrated farm equipment manufacturing complex is a prime factor in the economy of the Quad cities. In addition to the agriculturally-oriented industries, the largest cellophane manufacturing plant in the United States is located in Clinton, and a major rolling mill for the Aluminum Company of America is located in Bettendorf. Power production, grain milling, meat and poultry packing, and Federal arsenal activities, are also significant in industrial economy of the area.

Further industrialization is expected above Cordova, Illinois. Some 1,200 acres of land fronting on the Mississippi River have been leased by the Northern Natural Gas Products Company. It is planned to locate a petrochemical plant here, using the natural gas pipeline crossing at that point as a source for raw material. Extensive water use for process and cooling operations is expected as well as an increase in riverborne freight traffic.

* 1960 Census Report

WATER USES

Domestic water supply, industrial water supply and power production, commercial fishing, recreational boating, swimming, fishing, hunting, skiing, aesthetic enjoyment, and municipal and industrial waste disposal are all highly developed uses of the water in this river stretch.

Domestic Water Supply

Public water supplies are derived from the Mississippi River for the cities of Bettendorf and Davenport, Iowa, and of East Moline, Moline, and Rock Island, Illinois, as well as the U. S. Government Arsenal, Rock Island, and the Rock Island Railroad Yards at Silvis, Illinois. A total of 221,083 people in these communities depend upon the river as a domestic water supply source with 120,563 in Illinois and 100,515 in Iowa. Present daily use of water for domestic supply totals about 31.5 million gallons.

Industrial Water Supply

Seven major industries use the river as a source of industrial water supply in the river stretch under consideration. It is used for process purposes by the Clinton Corn Processing Plant. The Interstate Power plant at Clinton and the Riverside Power plant of the Iowa-Illinois Gas and Electric Company at Bettendorf use it as a source of condenser water. The John Deere plant in East Moline, Illinois, uses river water for cooling and for dust collecting in their foundry operations. The Aluminum Company of America in Bettendorf uses the river primarily as a cooling water source. The

Rock Island Railroad at Silvis, Illinois, treats water for boilers and the Rock Island Arsenal uses it for cooling and for process water in their plating operations. The average daily pumpage of river water for industrial use is at least 264 million gallons. Availability of adequate water supply must be considered as one of the primary reasons for plant location in most instances.

Additional use of the river for industrial water supply is in prospect, including the petrochemical plant near Cordova, mentioned on page 4; expanded operations, for alcohol production, at Clinton Corn Processing Company; and an ammonia products plant at Clinton, reported to be planned by Swift and Company with Skelly Oil Company. Three other industries are considering the Camanche area for plant location.

The twelve largest consumers of river water for municipal and industrial uses are listed in Table I.

Commercial Fishery

The Mississippi River commercial fisheries are of considerable economic importance. According to latest available information (1959) they provided full, or part-time, employment to at least 660 licensed operators in Illinois and Iowa. During the same year the total catch in the zone of this study, Pools 14 and 15, was over 603,000 pounds, worth approximately \$77,200.*

* Proceedings of the 17th Annual Meeting, Upper Mississippi River Conservation Committee, January 10, 1961.

TABLE I

MUNICIPAL AND INDUSTRIAL WATER USERS

<u>Community and Organization</u>	<u>Population Served</u>	<u>Pumpage MGD</u>	<u>Purpose</u>
Clinton, Iowa	-	15.85	Cooling and Process
Clinton Corn Processing Company	-	Undet.	Cooling and Process
E. I. du Pont de Nemours	-	Undet.	Condenser
Interstate Power Company	-		
Silvis, Illinois	500	0.34	Boiler, Cooling and Drinking
Rock Island Railroad Yards			
East Moline, Illinois	-	23.3	Condenser, Dust Collection
John Deere and Company	21,500	2.76	Municipal
Municipal Water Works			
Moline, Illinois	42,705	6.0	Municipal
Municipal Water Works			
Bettendorf, Iowa	-	187.0	Condenser
Riverside Power Plant	-	32.0	Cooling and Process
Aluminum Company of America			
Deavenport, Iowa	100,515	13.0	Municipal
Davenport Water Company			
Rock Island, Illinois	51,863	7.8	Municipal
Municipal Water Works	4,000	1.8	Drinking and Process
Rock Island Arsenal	221,083	295.35	

In view of the ever-growing population and demand for protein foods, it seems important not only to conserve this resource, but also to develop it to maximum production.

Recreational Uses

Recreation is a major use of the river. Boating, swimming, skiing, hunting, fishing and camping are activities supported by the river. Although almost one-half million people in the immediate vicinity have access to this river stretch, its recreational attractions also draw people from a much wider area including the metropolitan areas of Chicago and Des Moines.

To indicate the extensive boating use made of the river, a survey of some of the important marinas and boat clubs in the area showed that over 2,000 craft were docked at Clinton, Princeton and Cordova facilities during the boating season. An estimate of value of these craft would approach and probably exceed \$3,000,000. This does not include the servicing costs for launching, storage, gas, oil and the actual sports equipment necessary for fishing, hunting, and water skiing.

Organizations such as the YMCA, YWCA, Girl Scouts and Boy Scouts have established camp sites along the river in the Cordova to Port Byron area. Illinois also maintains a small state park, Illiniwek, below Dam 14. Both the YMCA and YWCA use the river for swimming and all organizations use it for canoeing, boating, fishing, and possibly water skiing. Some 500 girls and 500 boys in the 8-14 year age group use the YWCA and YMCA facilities, respectively. The Girl Scouts have a swimming pool. The Boy Scouts (Port Byron Troop)

use their site for camping and meetings only, although boating facilities are available. The YMCA is raising \$40,000 to construct a swimming pool. A primary justification voiced by these groups for constructing pools is that because of slimes and odor, the swimmers must take a soap and water shower after swimming in the river. The construction of swimming pools will not, however, eliminate exposure to the river since boating, canoeing and the challenge of a trans-Mississippi swim will remain as features of the camping programs.

Formations of fishing and boating clubs with memberships each measured in the hundreds indicate the great current interest and the potential for the future. The Izaak Walton League Chapters in the area (Clinton and Davenport) as well as the State organization in Illinois have been active in pressing for better recreational opportunities through improved water quality. Bank fishing and boat fishing are very popular. During the hunting season, ducks, geese and other wild fowl visit the river as a way station on the flyway between Canada and the Arkansas wintering area, and duck hunting is a major autumn sport.

In addition to these recreational uses, many permanent homes and summer cabins occupy the shores of both sides of the river. Most of these have private boats or boat docks. It is difficult to assess in economic terms the aesthetic value to residents of frontage on the river, but it must be considerable, otherwise these sites would not be held in such high favor.

Navigation

Commercial use of the river is reflected by the craft count maintained at the U. S. Corps of Engineers Lock and Dam 14, at LeClaire, Iowa. During the 1961 season up to September 30, a total of 8,637 craft were locked through. Of this total, 1,783 were commercial tows indicating the heavy navigational use being made of the river at this point. Pleasure craft numbered 6,854.

Agricultural Uses

Little direct agricultural use in the form of irrigation or stock watering is in evidence in the area, but there is a large potential for supplemental irrigation.

SOURCES OF WASTES

The river is much used for waste disposal by both municipalities and industries, some of which have no facilities, or inadequate facilities, for reduction of the sewage and industrial waste load before discharge to the stream. Davenport and Bettendorf, Iowa, use a common treatment facility for their municipal wastes but discharge the effluent to the Mississippi River below Dam 15. Rock Island, Illinois, and the Rock Island Arsenal have a similar system which also discharges below Dam 15.

Tables IIa and IIb list sewered communities from Clinton, Iowa, and Fulton, Illinois, to Rock Island, Illinois, and Davenport, Iowa, which border this reach of the Mississippi River. Table III lists sources of organic wastes, including both municipal sewage and industrial wastes. The basic information for these tables was taken

TABLE IIa

SOURCES OF SEWAGE DISCHARGED TO STREAM

	<u>Source</u>	<u>Sewered Population</u>	<u>Bacterial Population Equivalent To Stream</u>	<u>Per Cent of Total Discharge To Stream</u>
<u>Iowa</u>				
	Clinton	33,600	33,600	85.9
	Clinton Corn Processing Co.	1,400	1,400	3.7
	E.I. du Pont de Nemours and Co., Inc.	(1) 1,000	(5) 500	1.4
	Clinton Wire Cloth Co.	15	15	
	Curtis Companies, Inc.	Undet.	Undet.	
	Dairypak, Inc.	50	25 (5)	
	Maquoketa Co.	Undet.	Undet. (5)	0.1
	Interstate Power Co.	20E	10E	
	Pillsbury Mills Elevators	40	40	
	Clinton Rendering Co.	15	15	
	The Collis Co.	175E	175	0.4
	Swift and Co.	175E (2)	175	0.4
	Camanche	1,500	1,500 (6)	3.8
	Princeton	0 (3)	Undet.	
	LeClaire	1,500 (3)	1,500 (6)	3.9
	Pleasant Valley	0	Undet. (7)	
	Bettendorf	11,500 (4)	Undet. (8)	0.4
	Aluminum Co. of America	870	90 (8)	
	Davenport	89,000 (4)	Undet. (7)	
		<u>140,860</u>	<u>39,045</u>	<u>100.0</u>

(1) Estimated - Based on U. S. Department of Commerce Bulletin,
"Location of Manufacturing Plants." (1954)

(2) Town approximately 70% sewerred.

(3) Sewage plant under construction.

(4) Part of Davenport systems discharges to plant below Dam 15.

(5) Septic Tank - Assume 50% reduction in bacterial load.

(6) No organized collection system - Discharge indeterminate.

(7) Storm water overflows and incidental waste discharges which cannot be estimated.

(8) Trickling Filter - Assume 90% reduction of bacterial load.

TABLE IIb

SOURCES OF SEWAGE DISCHARGED TO STREAM

<u>Source</u>	<u>Sewered Population</u>	<u>Bacterial Population Equivalent To Stream</u>	<u>Per Cent of Total Discharge To Stream</u>
<u>Illinois</u>			
Fulton	3,400	3,400 ⁽⁴⁾	6.6
Albany	640	640 ⁽⁴⁾	1.2
Cordova	0	Undet. ⁽⁵⁾	-
Port Byron	1,150	1,150	2.3
Rapids City	0	Undet. ⁽⁵⁾	-
Hampton	0	Undet. ⁽⁵⁾	-
East Moline	24,000 ⁽¹⁾	12,000 ⁽⁶⁾	27.4
Moline	32,000 ⁽²⁾	32,000	62.5
Rock Island	51,900 ⁽³⁾	Undet. ⁽⁷⁾	-
	<u>113,090</u>	<u>49,190</u>	<u>100.0</u>

- (1) Based on 1960 census figures plus incremental industrial sanitary waste contributions plus packing house wastes. City is 90% sewered. Moline State Hospital included.
- (2) Estimated north slope population. South slope drains to Rock River (10,000 population). Two major sewer outfalls - 39th Street into river and 4th Street into Sylvan Slough.
- (3) Sewerage system includes Rock Island Arsenal wastes discharges to primary plant below Dam 15.
- (4) New plant under construction.
- (5) No organized collection system - Discharge indeterminate.
- (6) Primary treatment - Assume 50% reduction in bacterial load.
- (7) Storm water overflows and incidental waste discharges which cannot be estimated.

TABLE III

SOURCES OF ORGANIC WASTE DISCHARGE TO STREAM

Source	BOD Population Equivalent *		Per Cent of Total
	Individual Source	Total For Area	
<u>Iowa</u>			
Clinton	33,600	311,600	85.1
Pillsbury Mills - Soybean	58,000(1)		
Clinton Corn Processing			
Company	180,000		
E. I. du Pont de Nemours	40,000(1)		
Swift and Company	Undet.		
Clinton Rendering Company	Undet.		
Camanche	1,500	1,500	.4
LeClaire	1,550	1,550	.4
Bettendorf	N.A.		
Aluminum Co. of America	80	80	.1
<u>Illinois</u>			
Fulton	3,400	3,400	.9
Albany	640	640	.2
Port Byron	1,150	1,150	.3
East Moline	14,000(2)	14,000	3.8
Moline	32,000	32,000	8.8
		365,920	100.0

(1) Based on State of Iowa Survey - 1954.

(2) Based on 17-29% (average 25%) removal for primary plant with average influent BOD strength of 150 ppm, and average flow of 2.5 MGD.

from the "U. S. Public Health Service 1957 Inventory of Municipal and Industrial Waste Facilities," from the Iowa State Department of Health, and from the individual community and industrial facilities operators.

Sewage

Tables IIa and IIb give data both on sewered populations and the estimated bacterial population equivalents (BPE) of the sewage as discharged to the river. In certain cases the BPE is less than the corresponding sewered population. The difference represents estimated reduction in bacteria due to treatment of the waste water. As an example, the plant of the Aluminum Company of America at Bettendorf has a sewered population of 870, but the BPE value is listed as only 90. In this case, it was estimated that treatment reduced by 90 per cent the bacteria in the waste discharge.

The sewage from the E. I. du Pont plant, the Dairypak, Maquoketa and Interstate Power Plants in Clinton, Iowa, is passed through septic tanks before being discharged to the river. It is estimated that the bacterial content of the sewage is reduced by 50 per cent.

The untreated sewage from the City of Clinton, and from the Clinton Corn Processing Company, Swift and Company, the Collis Company, Curtis Companies, Inc., the Pillsbury Mills Company (Elevator Operation) and the Clinton Wire Cloth Company is discharged to the Mississippi River, Beaver Slough or Mill Creek, which is tributary to Beaver Slough.

The town of Camanche, Iowa, is constructing a sewage collection system with interceptor. Plans and specifications for the treatment

plant have been approved by the State of Iowa, but bids had not been let nor construction started.

The town of LeClaire, Iowa, had a sewerage system and primary treatment plant under construction in October 1961.

Fulton and Albany, Illinois, are building sewage treatment plants. The Fulton plant is of the primary type. Albany's sewage will be treated by the extended-aeration process. East Moline employs primary treatment, and since early last summer has extended the facilities of its sewerage system to the Moline State Hospital (population 2500) in the northern part of the city. About 90 per cent of the population of this city now have sewer service. Moline has sewage treatment for only 25 per cent of its population, and the sewage of about three quarters of the city drains into Sylvan Slough, an arm of the Mississippi, in two large outfalls at 39th Street and at 4th Street. The remaining population of Moline, comprising about 10,000 persons on the south slope, discharge through a primary treatment sewage plant into Rock River which empties into the Mississippi River below Dam 15. Moline is accumulating funds for construction of a north slope (Mississippi drainage) sewage treatment plant, by a special surcharge on water and sewage service billings.

Three of the communities mentioned above, Fulton, Albany, and East Moline, have received and accepted offers for construction grants for sewage treatment plants, under provisions of the Federal Water Pollution Control Act. In addition Moline has built its south slope plant and Davenport has enlarged its existing facilities with the aid of such grants.

With the exception of East Moline, Illinois, and the aforementioned industries served by some form of treatment systems, all of the other communities and industries were discharging sewage without treatment, and the sewered population and the BPE of each were the same. At the time of the survey, none of the plants under construction was treating any tributary wastes.

As indicated in the explanatory notes on Tables IIa and IIb, the Cities of Bettendorf and Davenport, Iowa, have a common collection system and a treatment plant which discharges its effluent to the Mississippi River below Dam 15. Similarly, the City of Rock Island and the Rock Island Arsenal discharge to a common treatment plant below Dam 15.

Figure 2 represents the sources of sewage discharged to this reach of the Mississippi River. The circles indicate the relative contributions of sewage bacteria from the various sources, with the diameter of the circle at each source in proportion to contributions from all other sources.

The survey area as a whole has a BPE of 88,300, and a sewered population of 253,950. The difference, equivalent to 165,650 population, represents removal either by sewage treatment (4.9 per cent) or by diversion outside the area (60.2 per cent) by the cities of Bettendorf, Davenport, and Rock Island. Of the total BPE of 88,300, municipal sewage discharges contributed 97.1 per cent, and industrial sanitary wastes discharges 2.9 per cent. Clinton municipal sewage contributed 38 per cent of the total bacterial loading; Moline, 36 per cent; East Moline, 13.6 per cent, and five remaining smaller communities, 9.5 per cent.

16a

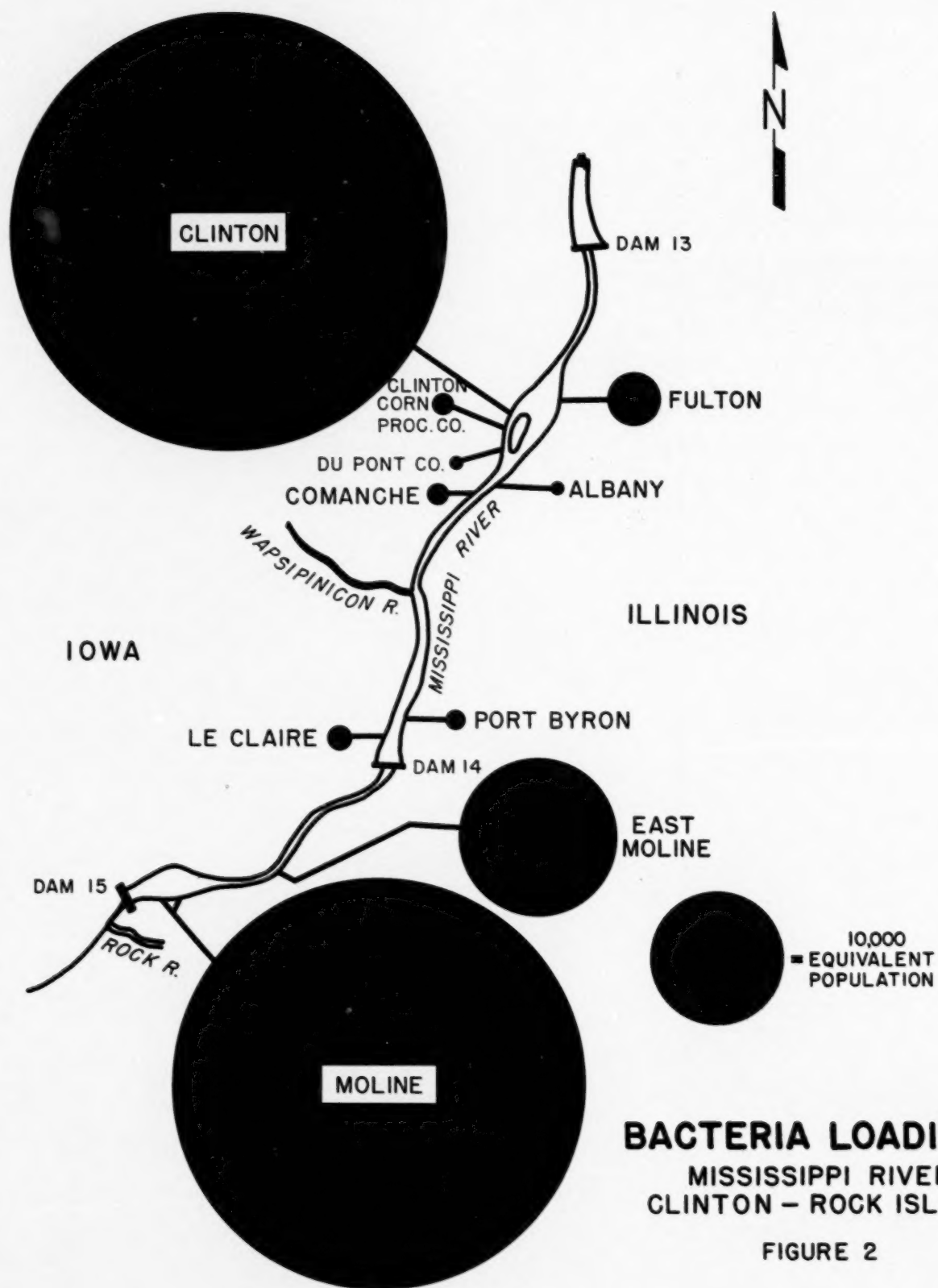


FIGURE 2

Organic Wastes

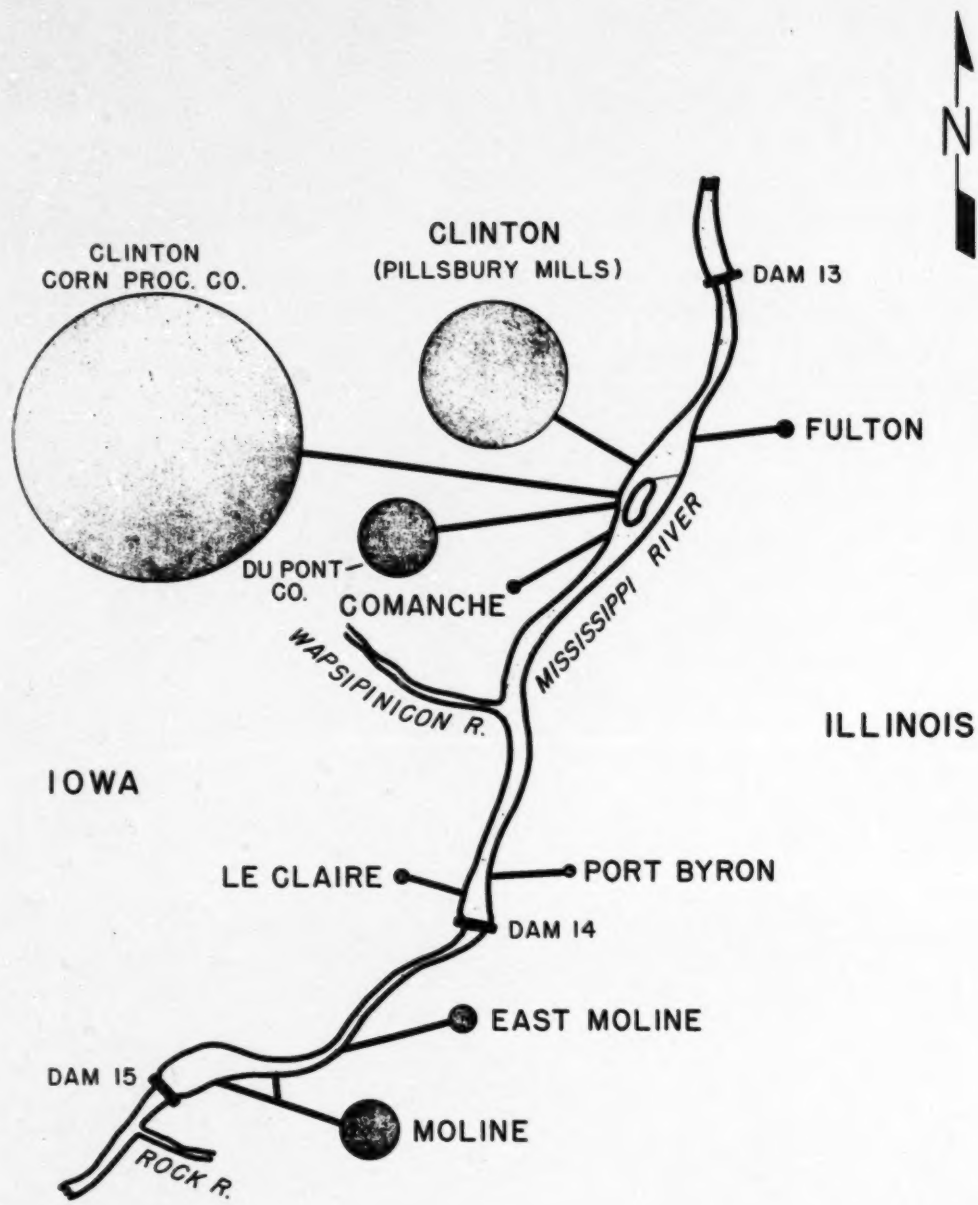
Figure 3 shows sources of sewage and industrial waste waters discharged to this reach of the river, with the relative loadings in proportion to diameters of the circles. The same information is given in tabular form in Table III. Values are expressed in terms of population equivalents (PE). The PE of industrial organic waste is computed by assuming a PE of six for each pound of 5-day biochemical oxygen demand (BOD) in the daily discharge of industrial wastes.

Total PE of the area is 366,000, of which 85 per cent comes from the Clinton area, 9 per cent from Moline, and 4 per cent from East Moline. The large contribution from Clinton area includes three major discharges of industrial waste, from Pillsbury Mills, Clinton Corn Processing Company, and du Pont Company.

Clinton Corn Processing wastes are estimated to have a PE of 180,000. In the 1954 study by the State of Iowa, Department of Public Health, the PE of this plant was estimated at 500,000. Processing refinements and economies developed since 1954 have thus reduced wastes production by 64 per cent. The PE per unit, of raw material processed (the bushel of corn) is presently about 2.7. Further improvement can be anticipated in the future, possibly down to a PE of 0.7 or less per bushel.* Any such reduction, however, would be partially vitiated by increases in plant output. One such increase is definitely in prospect with the completion of a new alcohol production unit, now under

* According to report on Clinton Corn Processing Company Waste Disposal by Hayse H. Black, Industrial Waste Consultant, October 31, 1961.

17a



ORGANIC WASTE LOADINGS

MISSISSIPPI RIVER
CLINTON — ROCK ISLAND

FIGURE 3

construction. The latter will require 3,000 to 6,000 bushels more of corn to be processed daily, thereby augmenting waste product by a PE of 8,000 to 16,000, under present conditions of operating efficiency. The waste discharge for this plant also includes at times a black substance which discolors a considerable portion of Beaver Slough below the plant.

The estimate of PE of wastes of the du Pont cellophane plant, 40,000, is believed conservative. It is based upon earlier measurements in the overflow channels of a waste water lagooning system, no longer in use. At present the waste waters are discharged direct to Beaver Slough, and may well be stronger upon reaching the river than they were before abandonment of the lagoons.

Other Wastes

Three reported fish kills have occurred in recent years due to discharge of toxic chemicals in the Clinton and Quad Cities areas. The Collis Company at Clinton was responsible for an accidental discharge of cyanide on September 6, 1961, and one in 1954. A similar discharge was traced to the Quad Cities area in November 1954. No definite identification of the offending industry or institution was made in the latter instance, although the plating operations at the U. S. Arsenal at Rock Island were circumstantially suspected. At the present time the Arsenal discharges all of its wastes to the Rock Island sewer system. Its plating operation has an alkaline-chlorine destruction unit for waste cyanides which reduces this toxic material to an innocuous condition before discharge.

EFFECTS ON WATER QUALITY AND USES

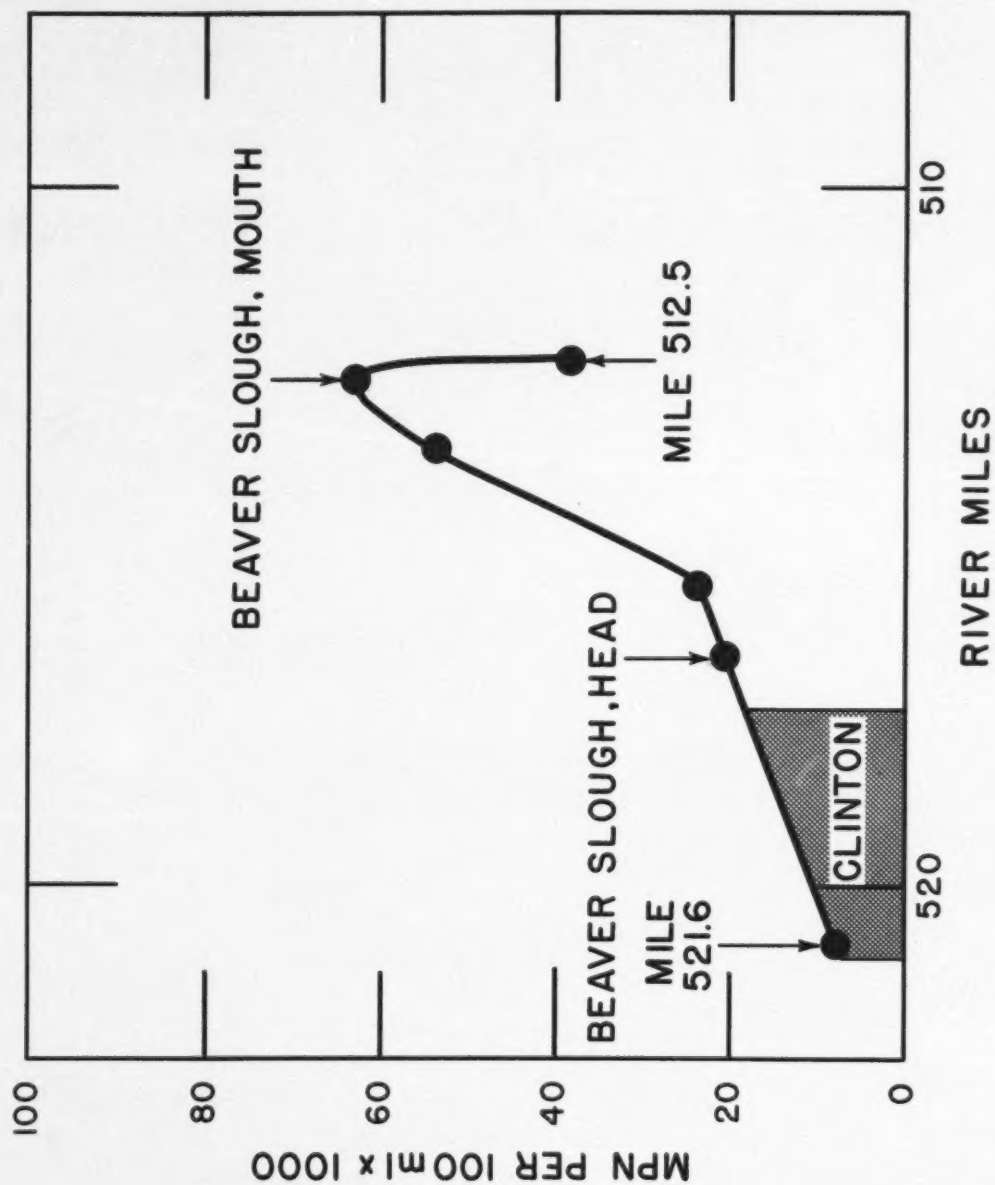
Localized effects of sanitary waste discharges in Beaver Slough and the reach of the Mississippi just below the slough are shown graphically in Figure 4.

Beginning at the first cross-sectional sampling station at stream mile 521.6, above Clinton, the seven-day mean coliform bacterial density, expressed in terms of most probable numbers (MPN), was 4,100 per 100 milliliters (ml), for the westerly half of the channel. The MPN's rose in progression downstream as shown below:

Beaver Slough, Station No. 2,	
100 yards below head	20,300
Beaver Slough, Station No. 3,	
north boundary of property of	
Clinton Corn Processing Company	23,700
Beaver Slough, Station No. 4,	
confluence with Mill Creek	53,300
Beaver Slough, Station No. 5,	
100 yards above mouth	63,300
Mississippi River, <u>westerly</u> half,	
Station No. 6, 0.2 miles below mouth	
of Beaver Slough, at Camanche	38,600

Seven-day, rather than nine-day mean values have been adopted because they are believed more nearly representative of ordinary conditions. Bacteria counts during the last two days of this survey were greatly increased by heavy rainfall, 1.12 inches on October 28, and 1.17 inches on October 29, as measured at the Quad Cities Airport.

19a



MPN PROFILE

MISSISSIPPI RIVER, WEST SIDE AT CLINTON, IOWA
(VIA BEAVER SLOUGH) - OCT. 23-29, 1961

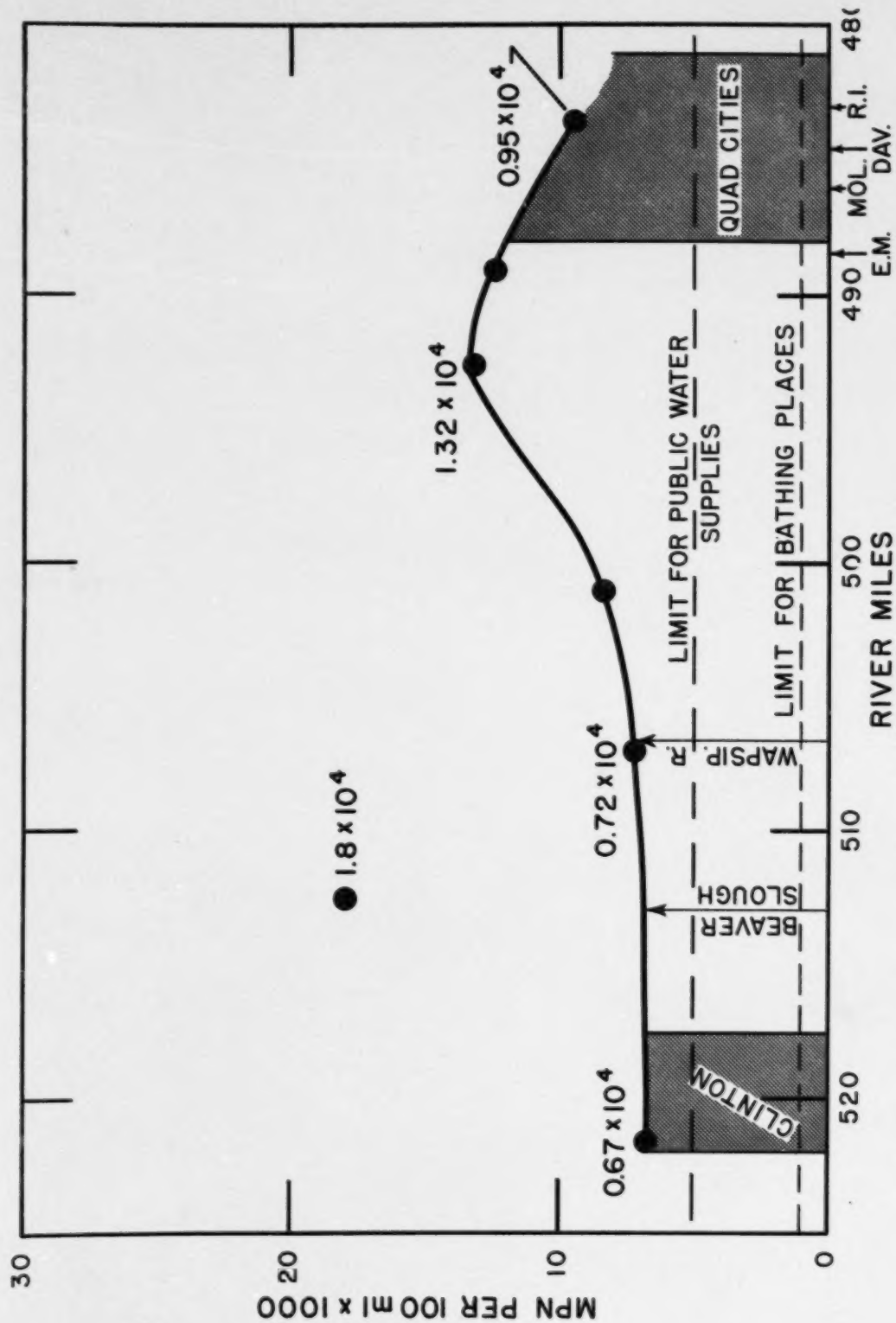
FIGURE 4

No serious effect of the waste discharges upon dissolved oxygen content within this reach was noted nor expected, because their time of flow in the slough was too short to permit significant oxidation, especially under the conditions of stream flow and low water temperatures prevailing at this season (9° - $12^{\circ}\text{C}.$)

A biological survey conducted October 21-23, 1961, revealed a "degraded collecting area ... on the Iowa shore downstream in a slough (i.e., Beaver Slough) between Clinton and a corn products plant: here the filamentous bacterium, Sphaerotilus, dominated and bottom deposits had a foul odor."

More widespread effects of bacterial loading of the river are shown in Figures 5 and 6. At the most northerly sampling range, mile 521.6, a short distance below Dam 13, bacterial density averaged 6,700 MPN per 100 ml. during the survey. It rose gradually to a peak of 13,250 above the Quad Cities zone, mile 492.5, and then declined to 9,500 in the pool immediately above Dam 15, at mile 483.5. This was the average for the range, or cross-section of the river, during dry-weather flow, excluding the final two days of the survey, when river discharge was doubled rapidly by rains. Individual locations sampled within the Pool displayed higher values: near East Moline waterworks intake, 41,200; Moline waterworks intake, 38,100; Davenport intake, 28,000; and Rock Island intake, 11,800.

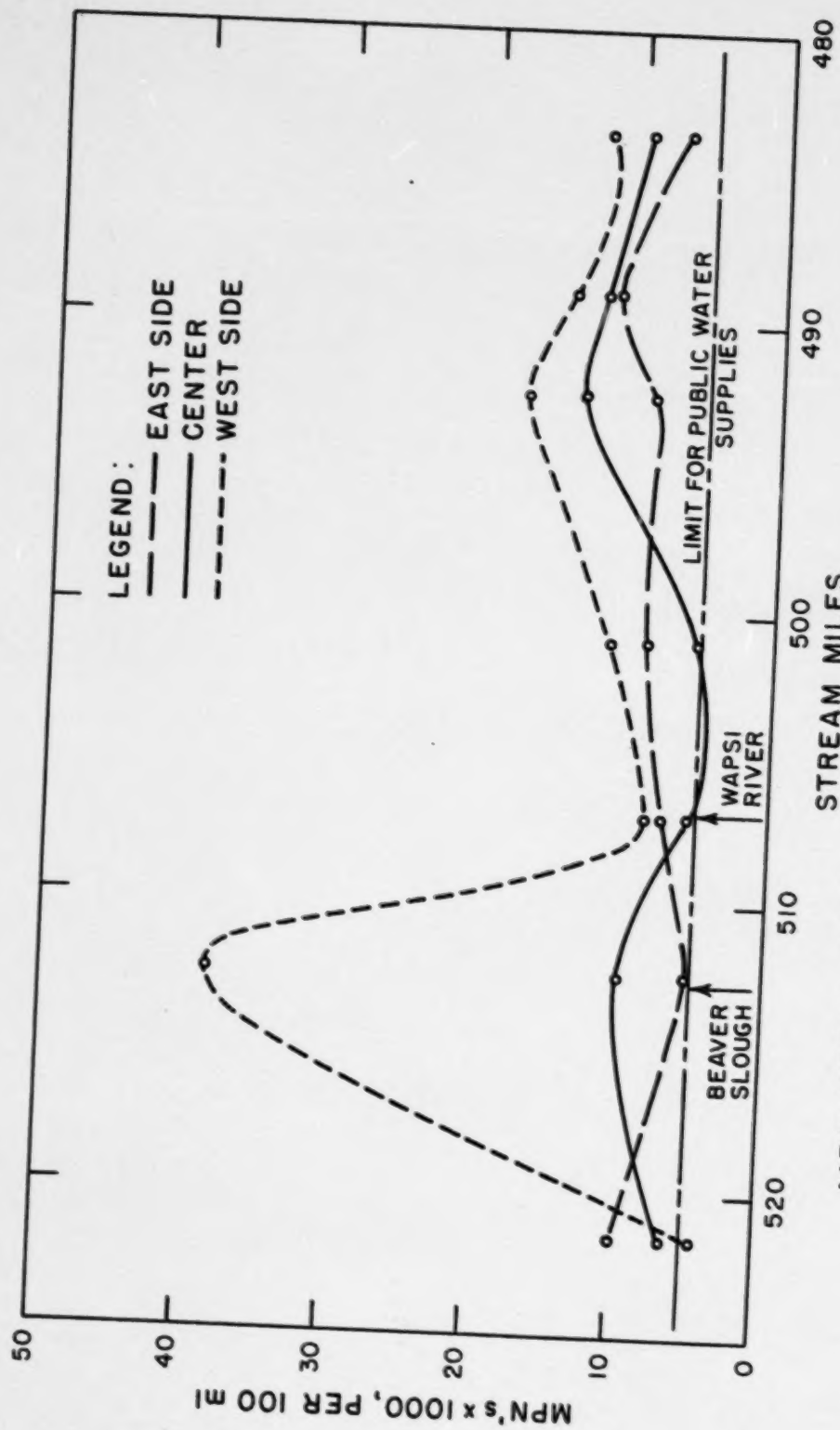
Findings of this survey in respect to bacterial population did not reveal the worst possible pollution. The latter would occur during simultaneous conditions of minimum river flow and maximum river water temperature. The historical monthly minimum flow is



MPN PROFILE-SEVEN-DAY PERIOD, OCT. 23-29, 1961

MISSISSIPPI RIVER
CLINTON — ROCK ISLAND
FIGURE 5

21a



MPN PROFILES-SEVEN DAY PERIOD, OCT. 23-29, 1961
FIGURE 6

11,120 second-feet, and the long-term monthly average, about 47,500 second-feet. During this survey, river flows averaged about 27,000 second-feet, and water temperatures, around 10°C.

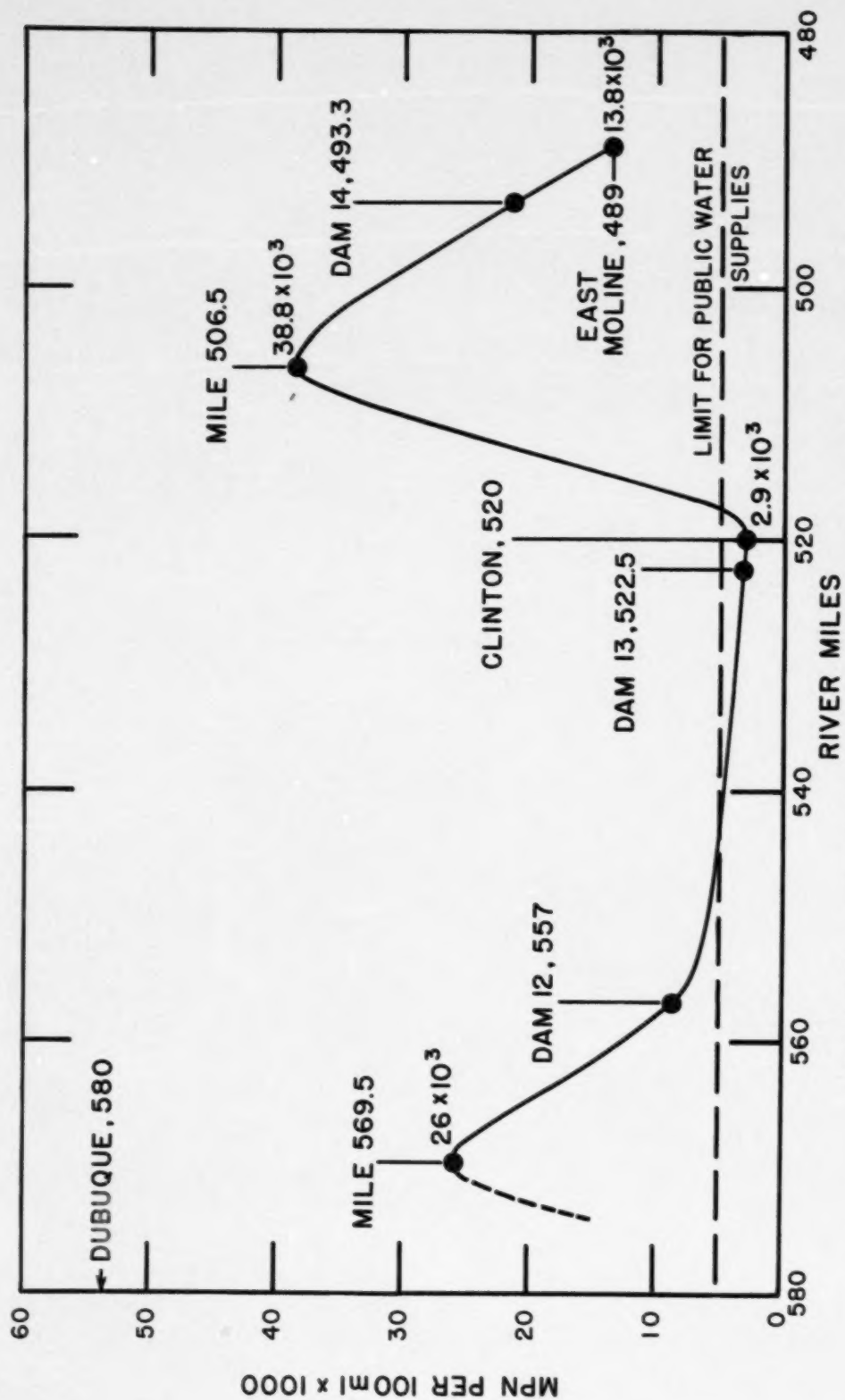
A monthly mean flow of 19,000 second-feet or less has a probability of occurring one year in five during August and September. An analysis of bacterial densities which might occur under such circumstances is shown graphically in Figure 7. With river water temperatures above 15°C, calculated bacterial densities would be about 38,800 MPN per 100 ml. at mile 506.5 in the Princeton-Cordova area, and 13,800 MPN per 100 ml. at mile 489 immediately above the Quad Cities. A further rise in bacterial pollution would occur in the Quad Cities zone owing to the discharge of untreated and partially-treated municipal sewage from Moline and East Moline. The effect of sewage discharges of the Dubuque, Iowa, area, has been considered in the calculation.

This calculation of summer bacterial densities tends to be confirmed locally by operating records for the Moline and East Moline water treatment plants in 1961. Excerpts from these records are shown in the following table:

Mean Monthly Coliform Counts, MPN per 100 ml.

	1961					
	<u>April</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sept.</u>
East Moline	2,700	3,600	18,000	32,000	23,800	47,000
Moline	16,200	28,600	47,700	46,700	40,000	59,000

It is of interest at this point to note and compare the laboratory records of coliform bacteria examinations of municipal raw water



**CALCULATED BACTERIAL DENSITIES FOR
SUMMER LOW FLOW CONDITIONS**

FIGURE 7

for the first week of this survey, October 23-27, 1961. The first column shows the findings of the Public Health Service mobile laboratory, the second, of the chemists of the respective municipal water treatment plants.

Five-day Mean Coliform Counts, MPN per 100 ml.
Raw Water Sources
October 23-27, 1961

	<u>PHS</u>	<u>Municipal</u>
East Moline	30,300	29,600
Moline	37,700	60,800
Davenport	16,800	18,600

The effects of total organic wastes, sewage plus industrial waste waters, from Clinton and vicinity are perceptible but small at this season and stream flow. They correspond to a reduction of 0.6 parts per million of dissolved oxygen, or about 12 per cent of the available capacity of the river to assimilate organic pollutants, before being degraded to the point of endangering normal aquatic life (assumed as 5.0 ppm). This effect would be intensified during warm weather, owing to the lesser solubility of oxygen in warmer waters. At 10°C. fresh water saturated with oxygen will dissolve 11.3 ppm, while at 30°C. solubility is reduced to 7.6 ppm.

The significance of the findings of this study, in relation to established beneficial uses of the Mississippi River, can be expressed as follows:

Domestic Water Supply

Quantitative limits for bacterial pollution in natural waters, which serve as sources of domestic water supply, have not been established for the Mississippi River by the States of Iowa and Illinois. Regulations of the State of Illinois, Department of Public Health, merely stipulate the type and degree of water treatment which shall be required for waters exceeding a given condition of coliform pollution.*

Views of the Public Health Service with respect to bacterial quality of sources of domestic water supply are given in the "Manual of Recommended Water Sanitation Practice, 1946." It is stated in effect that waters which fail to meet the following requirements are considered unsuitable for use as a source of water supply, regardless of type of treatment employed, unless first brought into conformance by "prolonged preliminary storage, or some other measure of equal permanence and reliability:"

- a. Coliform bacteria averaging not over 5,000 per 100 ml. in any one month, and
- b. Not over 20 per cent of samples exceeding 5,000 per 100 ml. in any one month, and
- c. Not over 5 per cent of samples exceeding 20,000 per 100 ml. in any one month.

* Public Water Supply Systems: Rules and Regulations, Illinois Department of Public Health, May 31, 1960.

These limits of bacterial pollution were exceeded for many months during the year 1961 at the waterworks intakes of the Cities of Moline and East Moline, as shown in Appendix A. The monthly coliform averages in September 1961 for the City of East Moline was nine times the recommended limit of 5,000. Moline's monthly average was 12 times the limit. During this survey in October 1961 the following values were reported:

Coliform Organisms, MPN per 100 ml.

<u>City</u>	<u>Mean</u>	<u>Maximum</u>
East Moline	41,200	79,000
Moline	38,100	130,000
Davenport	28,000	79,000
Rock Island	11,400	24,000

Visible evidence of pollution in the form of oil films and rubber prophylactics has been seen daily at the Davenport waterworks and occasionally at the Rock Island Arsenal intake. Oil and grease occur occasionally at the Moline plant and the Rock Island waterworks reported that the surface of the settling basins has been plagued with a malodorous scum of unidentifiable origin in recent months.

Tastes and odor problems in the raw water requiring increased chemical dosages, particularly of carbon, occur occasionally at each of the waterworks. In addition unexplained changes in raw water quality at the Moline plant have required rapid fluctuation in alum dosage.

Under the circumstances described above it is a tribute to the competency of operating personnel of these water treatment plants that they have been able consistently to produce treated waters of safe bacterial quality. It appears hazardous, however, to continue indefinitely under conditions of bacterial overloading, lest failures occur.

Industrial Water Supply

As indicated in Table I, industrial uses of Mississippi River water greatly exceed domestic use. The chief industrial uses of river water are for cooling, condenser and dust collection processes.

Quality of water for these rough industrial uses does not appear to have suffered excessively so far, although one large industry, The John Deere Company, of East Moline, reported an increase of slime growths during the past few years which, if continued, would require provision of treatment for their reduction.

The Aluminum Company of America and the Iowa-Illinois Gas and Electric thermal power plant in Bettendorf both practice intermittent chlorination for reduction of organic slimes in water intake equipment.

Recreation

The extensive uses of this reach of the Mississippi River for recreation and their economic and social importance have been described in a preceding section. Under present conditions the Mississippi River in this reach is degraded far beyond accepted limits of bacterial water quality for bathing, swimming and other sports involving direct water contact.

The Illinois State Department of Health adopted rules and regulations on January 11, 1961, which govern organized camp use of natural bathing areas. Two primary standards set by this agency are the total coliform and enterococci counts as MPN/100 ml. For total coliforms a natural bathing area is judged unsatisfactory when the MPN/100 ml. is greater than 500. Although this value is a controlling factor only for use by organization camps, its extension as a criterion for recreational use by others appears logical.

Quality objectives of the State of Iowa are expressed in the "Tentative Guide for Water Pollution Control Activities" dated February 27, 1952, of the Missouri Basin Health Council, of which Iowa is a member, as follows: "For bathing and swimming waters, monthly arithmetical average 'most probable number' of coliform organisms should not exceed 1,000 per 100 ml. during any month of the recreation season; nor exceed this number in more than 20 per cent of the samples examined during any such month; nor exceed 2,400 per 100 ml. on any day." The values cited apply particularly to the Missouri River Basin, but can perhaps be extended logically to other waters of the State, including the Mississippi.

During the present survey, coliform MPN's exceeded 1,000 per 100 ml. in all of the 211 samples taken at the seven mainstem sampling stations on the Mississippi River. Their values ranged from 2,300 (low) to 130,000 for the flows and water temperatures existing at the time of the survey. The bacterial densities during the summer period under similar flow conditions and higher temperatures would be expected to be higher as indicated in Figure 7.

Even discounting the effects of temperature and low flow, the average coliform concentration was around 13,000 per 100 ml. above the Quad Cities. This means that each drop of water splashed from the prow of a boat into an occupant's face would contain about seven "sewage bacteria." Occasional maximum concentrations in the same area were about 130,000 per 100 ml.

The increasing popularity of water skiing is rapidly multiplying the numbers of persons who, when they fall into the water and submerge, receive even greater exposure to the contaminated water than do the boaters.

On the basis of either the measured densities or expected summer coliform densities, safety limits recognized by the two States for these or other waters are greatly exceeded. Strict adherence to these criteria of water quality would preclude the use of the river for most water sports for the several hundred thousand people having access to this river stretch.

The presence of visible sewage solids, oil and toxic wastes discharged in untreated sewage and industrial waste waters is likewise incompatible with any recreational use of natural waters or with their aesthetic enjoyment. The YMCA camp swimming area below Cordova, Illinois, has in the past been littered by refuse, including garbage from the Princeton, Iowa, area. This condition has been corrected but is another indication of the interstate transfer of pollutorial material.

Conservation of Fish and Wildlife

Dissolved oxygen levels inimical to fish and other higher aquatic life were not found during this survey, and do not appear likely to occur generally under present conditions of waste discharge. The biological survey revealed localized degradation of aquatic life in Beaver Slough, an arm of the Mississippi below Clinton.

Continual complaints of net and line fouling with slimes have been made by commercial fishermen. This is particularly true in the Princeton-Cordova area. Although no detrimental effect to the fish is apparent, the fouling of nets undoubtedly reduces netting efficiency, and may damage nets and lines. Fish kills due to the accidental discharge of toxic industrial wastes have occurred three times in 1954 and 1961, and emphasize the need for vigilance to prevent such mishaps.

SUMMARY AND CONCLUSIONS

A field survey was made October 23-31, 1961, to ascertain effects of sewage and industrial waste discharges on water quality and uses of the Mississippi River between Clinton, Iowa and the Quad Cities area, 39 miles downstream.

The results of the survey show that bacterial pollution from the Clinton area affects important water uses downstream. Sources of domestic water supplies for the cities of East Moline, Moline, Rock Island and Davenport, and similar supplies for industrial facilities such as the Rock Island Arsenal and the Rock Island Railroad Yards at Silvis, Illinois are all affected by the high bacterial densities contributed by the Clinton area. These are in excess of the limits recognized as safe by the Public Health Service, and are independent of the sizable bacterial loads applied by sewage plant discharge from the City of East Moline, the raw sewage discharge from Moline, and from wastes entering the river above Clinton. Visible evidence of sewage pollution occurs at the Davenport, Moline, Rock Island and the Arsenal's water treatment works in the form of oil films, foam and floating rubber prophylactics.

The extensive use of this stretch of the river for recreation by almost one-half million people in the riparian counties bordering it would be debarred on the basis of criteria for natural bathing areas as recognized by the States of Iowa and Illinois. These criteria are exceeded many times over. Notwithstanding its polluted condition, the river is used, and the users are being

exposed to at least a concentration of seven "sewage bacteria" per drop of water which was present at the time of the survey. This concentration is no doubt much higher under summer low flow conditions and emphasizes the health hazard for not only the multitude of youngsters using YWCA, YMCA, Girl Scout and Boy Scout facilities along the river, but also for the many thousands of other boaters, bathers, water skiers, riparian residents, fishermen, hunters and picnickers.

Other effects of pollution included the fouling of commercial fishing nets and lines with organic slimes and similar growths in water intakes of industrial users. Degraded-water forms of aquatic life were found in Beaver Slough, and occasional fish kills have been caused by release of toxic industrial wastes.

It is concluded that the bacterial quality of interstate waters of the Mississippi River between Clinton, Iowa, and Rock Island, Illinois is undesirable for waters used as a source of public supply and for recreation. Principal sources of pollution are at Clinton, Iowa; East Moline and Moline, Illinois and from points above Dam 13. Undesirable effects are believed to be augmented by large discharges of organic industrial wastes at Clinton. It is evident that pollution of the Mississippi River by certain riparian communities and industries in the reach between Dams 13 and 15 constitutes pollution of interstate waters, subject to abatement under the Federal Water Pollution Control Act, as such pollution endangers the health or welfare of persons in a state other than that in which the discharge contributing to such pollution originates.

APPENDIX A

HISTORICAL ABSTRACT OF WATER POLLUTION, CLINTON - QUAD CITIES REACH, MISSISSIPPI RIVER, 1943-1961.

May, 1943

Commercial fishermen complain of wastes fouling nets from Clinton to Davenport.

1944-1945

Fish and Wildlife Survey - "showed pollution limited largely to local areas below cities and industrialized areas. However, would not admit that pollution was great enough to cause harm to present fish fauna, but cautioned that the safety margin was narrowed."

1944-1946

Technical Committee of the Upper Mississippi conducted field study of fishery resources from Dubuque, Iowa, to Caruthersville, Missouri. At Cordova, Illinois, commercial fishermen complained of sliming of hoop nets--attributed to waste discharge from Clinton, Iowa, area 15 miles upstream, however, no apparent effect on fish.

1951

Iowa law changed to include Mississippi River in pollution control jurisdiction.

1951

City of Clinton Engineer's office prepared preliminary study of interceptor problem and location of STP. New pumping stations installed in 1952 fit into such an interceptor system.

APPENDIX A (CONTINUED)1952

Mississippi River floods major portion of tributary areas of certain sewers. Corps of Engineers installed pump stations since construction of Lock and Dam 14 at Le Claire, Iowa. The pool formed was responsible for back up and pump stations installed to alleviate same. However, has not entirely relieved situation. Health hazard exists due to back up into basements.

March, 1952

Upper Mississippi Conference on Water Pollution. Agreement among Iowa, Illinois and Wisconsin, pollution control groups on abatement program. Requires minimum primary treatment for all municipalities and industries with elimination of toxic substances to harmless level. More sophisticated treatment if conditions warrant. City of Clinton representatives attended this conference.

June 2, 1952

Petition by Clinton County Chapter of Izaak Walton League to investigate pollution of Mississippi River below Clinton.

July, 1954

Report on the Water Pollution Investigation of the Mississippi River and its tributaries in and below Clinton, Iowa, by the Iowa State Department of Health.

1955

State of Iowa restricts sewer extensions contingent upon providing intercepting sewers and treatment plant.

1957

Consoer, Townsend and Associates, Consulting Engineers hired by City of Clinton to prepare preliminary engineering report.

APPENDIX A (CONTINUED)1958

Engineering report submitted calling for total expenditure of \$6,000,000 for storm sewer, trunk sewer, interceptor sewer, and treatment plant construction. Recommended plant cost estimated at \$1,125,000, interceptor sewers at \$2,760,000, trunk sanitary sewers at \$585,000 and storm water relief facilities at \$1,175,000. Per capita costs based on design population of 45,000 for plant alone would be \$23.40; for interceptor and plant together at total cost of \$3,885,000 would be \$86.50; total per capita costs for entire project (\$6,000,000) based on design population would be \$133.00.

March, 1960

Meeting of U. S. Public Health Service representatives, State of Iowa and Clinton officials. Tentative time schedule set up for financing arrangements to be completed within 90 days of the meeting.

To date-1961

No action by City to implement program, although it is reported that the Corn Products Plant had substantially reduced its industrial waste load discharge. (According to news report by Mayor Dall, industry in Clinton area reduced load from 500,000 PE to 180,000 PE by August, 1960).

1960-1961

Illinois communities of Fulton (pop. 3,388) and Albany (pop. 550) and Le Claire, Iowa (pop. 1,546) start construction of sewage collection and treatment facilities. Per capita costs for Fulton on basis of design population of 4,500 are estimated at \$33.00 for the primary plant and \$74.00 for the total project. Albany with a design population of 750 has an estimated per capita cost of \$96.00 for an extended aeration plant and \$361.00 for the total project.

APPENDIX A (CONTINUED)October, 1961

Industrial waste survey made by Hayse H. Black at the Corn Products Plant for State of Iowa.

1961

Coliform counts per 100 ml. (monthly average and maximum) for the downstream communities of East Moline, Moline, Rock Island and Davenport are as follows according to data furnished by water plant management:

APPENDIX A (CONTINUED)

<u>Rock Island Water Works</u> (Intake at Illinois-Iowa line)	<u>Month & Year</u>	<u>Coliform Count MPN/100 ml.</u>	
		<u>Average</u>	<u>Maximum</u>
	January 1961	2,606	11,000
	February 1961	2,900	11,000
	March 1961	2,080	7,200
	April 1961	1,330	11,000
	May 1961	626	6,900
	June 1961	1,240	7,300
	July 1961	1,279	2,400
	August 1961	985	6,900
	September 1961	3,867	14,000
 <u>Moline Water Works</u>			
	March 1961	20,270	70,000
	April 1961	16,179	70,000
	May 1961	28,577	70,000
	June 1961	47,670	70,000
	July 1961	46,748	70,000
	Oct. 23-27 1961	60,800	70,000
 <u>East Moline Water Works</u>			
	February 1961	5,863	24,000
	March 1961	7,877	24,000
	April 1961	2,700	6,200
	May 1961	3,567	24,000
	June 1961	18,000	70,000
	July 1961	32,000	70,000
	August 1961	23,800	70,000
	September 1961	47,000	70,000+
	Oct. 23-27 1961	30,300	79,000
 <u>Davenport, Iowa Water Works</u>			
	<u>1961 Week Ending</u>		
	July 1	2,014	2,500
	" 8	1,400	1,900
	" 15	2,029	4,800
	" 22	1,470	2,500
	" 29	4,100	9,400
	August 5	4,300	12,000
	" 12	6,140	12,000
	" 19	2,414	3,500
	" 26	1,957	3,000
	September 2	2,700	4,200
	" 9	2,929	8,000
	" 16	27,814	100,000

APPENDIX A (CONTINUED)

October 26, 1961 --- State of Iowa, Department of Public Health cites the cities of Clinton and Camanche, Iowa and six industrial plants for pollution of Mississippi River in hearing at Des Moines, Iowa.

December 4, 1961 --- Clinton City Council authorizes Consoer, Townsend and Associates, Chicago consulting engineers, to proceed with preparation of plans, specifications and estimates for construction of primary sewage treatment plant and intercepting sewers.

APPENDIX B

Tabulation

of

Stream Flows and Laboratory Data

(1)									
Date	Station Number	Stream Mile	River Disch. cfs	Water Temp. °C.	Dissolved Oxygen ppm	Percent D.O. satur.	MPN per 100 ml	E. Coli per 100 ml	Remarks
x1000									
1961	Mississippi River								
10-23	#1 L	521.6	26.2	10.5	9.69	86.5	7900	3300	East Channel
24			24.7	10	9.80	86.7	24000	13000	
25			25.4	10	10.10	89.3	2300	2300	
26			25.8	9	10.40	89.6	4900	1300	
27			24.3	9	10.78	92.9	4900	3300	
28			23.4	9	10.62	91.6	17200	3300	
29			26.2	10	10.50	92.9	7900	4900	
30			48.0	10	10.59	93.7	10900	4900	
31			51.1	10	10.00	88.5	17200	7900	
Section Mean Values									
Oct. 23-29									
Oct. 23-31									
10-23	#1 C	521.6	26.2	10.5	9.65	86.1	7900	3300	Center Channel
24			24.7	10	9.71	85.9	10900	10900	
25			25.9	10	10.00	88.5	2300	2300	
26			25.8	8	10.36	87.1	4900	1300	
27			24.3	9	10.73	92.5	3300	1700	
28			23.4	9	10.46	90.2	10900	3100	
29			26.2	10	10.49	92.8	3300	1700	
30			48.0	10	10.54	93.3	10900	7000	
31			51.1	10	9.59	84.9	33000	17200	

(1) Preliminary figures, subject to revision.

Tabulation

Stream Flows and Laboratory Data

B-2

APPENDIX B (CONTINUED)

Tabulation of Stream Flows and Laboratory Data

Date	Station Number	Stream Mile	River Disch. cfs	Water Temp. °C	Dissolved Oxygen ppm	Percent D.O. satur.	MPN per 100 ml	E.Coli per 100 ml	Remarks
1961									
10-23	#3	1-1/4 below N.end		11	9.45	85	17200	7900	Beaver Slough
24		N.end		10	9.98	88	7000	3300	
25		N.side		10	10.20	90	17200	7000	
26		Clinton		9	10.30	89	49000	7000	
27		Corn Co. property		9	11.06	95	9400	2300	
28				9	10.47	90	17200	7900	
29				10	10.57	94	49000	10900	
30				11	10.52	95	17200	1700	
31				10	9.90	87	24000	4900	
				9.7	10.29	90	23700	5485	
				9.9	10.27	90	23000	5000	
10-23	#4	2.8 below N.end		11	9.54	86	79000	13000	Beaver Slough
24		at Mill Creek confluence		10	9.99	88	7900	7900	
25				10	10.25	91	6300	6300	
26				10	10.17	90	10900	10900	
27				9	11.10	96	7900	2200	
28				9	10.39	90	240000	49000	
29				10	10.51	93	21000	2000	
30				11	10.57	95	22100	3300	
31				10	9.96	88	24000	7900	
				9.9	10.28	90.6	53300	13040	
				10	10.27	90.8	46600	11400	
10-23	#3	1-1/4 below N.end		11	9.45	85	17200	7900	Beaver Slough
24		N.end		10	9.98	88	7000	3300	
25		N.side		10	10.20	90	17200	7000	
26		Clinton		9	10.30	89	49000	7000	
27		Corn Co. property		9	11.06	95	9400	2300	
28				9	10.47	90	17200	7900	
29				10	10.57	94	49000	10900	
30				11	10.52	95	17200	1700	
31				10	9.90	87	24000	4900	
				9.7	10.29	90	23700	5485	
				9.9	10.27	90	23000	5000	
10-23	#4	2.8 below N.end		11	9.54	86	79000	13000	Beaver Slough
24		at Mill Creek confluence		10	9.99	88	7900	7900	
25				10	10.25	91	6300	6300	
26				10	10.17	90	10900	10900	
27				9	11.10	96	7900	2200	
28				9	10.39	90	240000	49000	
29				10	10.51	93	21000	2000	
30				11	10.57	95	22100	3300	
31				10	9.96	88	24000	7900	
				9.9	10.28	90.6	53300	13040	
				10	10.27	90.8	46600	11400	

APPENDIX B (CONTINUED)

Tabulation
of

Stream Flows and Laboratory Data

Date	Station Number	Stream mile	River Disch. cfs	Water Temp. °C	Dissolved Oxygen ppm	Percent D.O. satur.	MPN per 100 ml	E. Coli per 100 ml	Remarks
1961									
10-23	#5	100 yds. above mouth	x1000						
24			11	9.41	85	172000	7900		Beaver Slough
25			10	9.88	87	33000	7900		
26			10	10.00	88	141000	10900		
27			10	9.73	86	8000	5000		
28			9.5	10.78	95	17200	10900		
29			10	10.27	91	49000	7900		
30			10	10.60	94	23000	5000		
31			11	10.60	95	24000	7900		
			10	10.02	89	49000	7000		
			10	10.01	89.4	63300	7930		
			10.2	10.14	90	57400	6700		
			Oct. 23-29 mean						
			Oct. 23-31 mean						
Mississippi River									
10-23	#6	L 512.5	26.2	11	9.68	87.2	3300	2300	East Channel
24			24.7	10	9.84	87.1	7900	7900	
25			25.4	10	10.27	90.9	3300	2300	
26			25.8	10	10.28	91.0	3300	2300	
27			24.3	9	10.90	94.0	3300	3300	
28			23.4	9	10.68	92.1	13000	2300	
29			26.2	10	10.66	94.3	3300	3300	
30			48.0	10	10.75	95.1	10900	3300	
31			51.1	10	10.18	90.1	22100	7900	

APPENDIX B (CONTINUED)

Tabulation of Stream Flows and Laboratory Data

Date	Station Number	Stream Mile	River Disch. cfs	Water Temp. °C	Dissolved Oxygen ppm	Percent D.O. satur.	MPN per 100 ml	E.Coli per 100 ml	Remarks
x1000									
1961	#6 C	512.5	26.2	11	9.53	85.8	4900	2300	Center Channel
10-23			24.7	10	9.90	87.6	7000	3300	
24			25.4	10	10.30	91.2	4900	3300	
25			25.8	10	10.29	91.1	24000	13000	
26			24.3	9	11.00	94.8	7000	1700	
27			23.4	9	10.52	90.7	17200	7000	
28			26.2	10	10.60	93.8	4900	800	
29			48.0	10	10.65	94.2	24000	13000	
30			51.1	10	9.96	88.1	33000	7900	
31			26.2	11	9.45	85.1	22100	4900	
10-23			24.7	10	9.75	86.3	24000	4900	
24			25.4	10	10.25	90.7	10900	3300	
25			25.8	10	10.11	89.5	22100	8000	
26			24.3	9	10.60	91.4	33000	7000	
27	23.4	10	10.03	88.8	79000	13000			
28	26.2	10	10.20	90.3	79000	7900			
29	48.0	11	10.24	92.3	33000	13000			
30	51.1	10	9.79	86.6	24000	2300			
31									
Section Mean Values									
Oct. 23-29				9.9	10.23	90.0	18000	5030	
Oct. 23-31				10.0	10.24	90.4	19400	5700	

APPENDIX B (CONTINUED)

Tabulation of Stream Flows and Laboratory Data

Date	Station Number	Stream Mile	River Disch. cfs	Water Temp. °C	Dissolved Oxygen ppm	Percent D.O. satur.	MPN per 100 ml	E. Coli per 100 ml	Remarks
<u>Mississippi River</u>									
1961	#7 L	507.1	xl000						East Channel
10-23			26.2	11	9.37	84.4	3300	3300	
24			24.7	10	9.65	85.4	17200	1700	
25			25.4	10	9.92	87.8	4900	3300	
26			25.8	10	10.11	89.5	7900	2300	
27			24.3	8	10.62	89.2	7900	3300	
28			23.4	9	10.50	90.5	4900	3300	
29			26.2	10	10.56	93.4	4900	-	
30			48.0	10	10.70	94.7	7900	1700	
31			51.1	10	10.31	91.2	24000	3300	
<u>Center Channel</u>									
1961	#7 C	507.1	xl000						
10-23			26.2	11	9.60	86.5	7000	3300	
24			24.7	10	9.75	86.3	1700	3300	
25			25.4	10	9.98	88.3	4900	3300	
26			25.8	10	10.02	88.7	3300	2300	
27			24.3	9	10.28	88.6	3300	2300	
28			23.4	9	10.43	89.9	13000	2300	
29			26.2	10	10.54	93.3	missing	7900	
30			48.0	10	10.60	93.8	7900	3300	
31			51.1	10	10.19	90.2	4900	2900	

Tabulation
of

Stream Flows and Laboratory Data

B-7

Wapsipinicon R.

APPENDIX B (CONTINUED)

Tabulation
of
Stream Flows and Laboratory Data

Date	Station Number	Stream Mile cfs	River Disch. cfs	Water Temp. °C	Dissolved Oxygen ppm	Percent D.O. satur.	MPN per 100 ml	E. Coli per 100 ml	Remarks
x1000									
<u>Mississippi River</u>									
1961	#8 L	501.0	28.4	11	8.90	80.2	24000	3300	East Channel
10-23			26.8	10	9.44	83.5	4600	1300	
24			27.4	10	9.91	87.7	4900	3300	
25			27.7	10	10.34	91.5	3300	1300	
26			26.1	9	10.30	88.8	7000	700	
27			25.2	9	10.50	90.5	7900	1400	
28			28.0	-	-	-	-	-	
29			49.8	10	10.36	91.7	24000	4900	
30			53.0	10	10.38	91.8	24000	3300	
31									
<u>Center Channel</u>									
10-23	#8 C	501.0	28.4	11	9.81	88.4	3300	2300	
24			26.8	10	9.35	82.7	7900	7900	
25			27.4	10	9.91	87.7	4900	2200	
26			27.7	10	10.10	89.4	7900	1700	
27			26.1	9	10.28	88.6	3300	2300	
28			25.2	9	10.65	91.8	3300	1300	
29			28.0	-	-	-	-	-	
30			49.8	10	10.34	91.5	7900	4900	
31			53.0	10	10.21	90.4	33000	2300	

APPENDIX B (CONTINUED)

Tabulation of

Stream Flows and Laboratory Data

Date	Station Number	Stream Mile	River Disch. cfs	Water Temp. °C	Dissolved Oxygen ppm	Percent D.O. satur.	MPN per 100 ml	E. Coli per 100 ml	Remarks
1961									
10-23	#8 R	501.0	28.4	11	9.10	82.0	3300	1300	West Channel
24			26.8	10	9.30	82.3	17200	1700	
25			27.4	10	9.55	84.5	17200	77000	
26			27.7	10	9.83	87.0	13000	4900	
27			26.1	9	10.10	87.1	7900	3300	
28			25.2	9	10.54	90.9	7900	2200	
29			28.0	-	-	-	-	-	
30			49.8	11	9.54	85.9	33000	7900	
31			53.0	10	9.80	86.7	13000	2300	
Section Mean Values									
10-23-29				9.8	9.88	87.0	8300	2670	
Oct. 23-31				9.9	9.94	87.6	11800	3070	
Mississippi River									
1961	#9 L	492.5	28.4	12	8.76	81.1	4600	2300	East Channel
10-23			26.8	12	9.19	85.1	7900	2300	
24			27.4	11.5	9.39	85.7	17200	4900	
25			27.7	-	-	-	13000	4900	
26			26.1	10	9.97	88.2	4900	1700	
27			25.2	10	10.60	93.8	4900	2300	
28			28.0	-	-	-	-	-	
29			49.8	11	10.30	92.8	33000	2300	
30			53.0	11	10.13	91.3	49000	4900	
31									

APPENDIX B (CONTINUED)

Tabulation
of
Stream Flows and Laboratory Data

Date	Station Number	Stream Mile	River Disch. cfs	Water Temp. °C	Dissolved Oxygen ppm	Percent D.O. satur.	MPN per 100 ml	E. Coli per 100 ml	Remarks
Mississippi River xl000									
1961	#9 C	492.5	28.4	12	9.05	83.8	24000	1700	Center Channel
10-23			26.8	12	8.94	82.8	22100	2200	
24			27.4	12	9.45	87.5	4900	3300	
25			27.7	10	9.61	85.0	14100	4600	
26			26.1	10	9.76	86.4	13000	4900	
27			25.2	10	10.46	92.6	3300	2300	
28			28.0	-	-	-	-	-	
29			49.8	11	9.98	89.9	46000	2300	
30			53.0	11.5	9.93	90.7	12000	4900	
31									
10-23	#9 R	492.5	28.4	11	9.01	81.2	9400	2600	West Channel
24			26.8	12	8.89	82.3	13000	3300	
25			27.4	12	9.20	85.2	22100	4900	
26			27.7	10.5	9.30	83.0	14100	4900	
27			26.1	10	9.60	84.9	33000	3300	
28			25.2	10	10.39	91.9	13000	7900	
29			28.0	-	-	-	-	-	
30			49.8	11	9.95	89.6	130000	7000	
31			53.0	11.5	9.71	88.7	-	-	
Section Mean Values									
				Oct. 23-29	11.0	85.9	13250	3570	
				Oct. 23-29	11.0	87.1	22100	3800	

APPENDIX B (CONTINUED)

Tabulation of

Stream Flows and Laboratory Data

Date	Station Number	Stream Mile	River Disch. cfs	Water Temp. °C	Dissolved Oxygen ppm	Percent D.O. satur.	MPN per 100 ml	E. Coli per 100 ml	Remarks
Mississippi River									
x1000									
1961	#10 L	489.0	28.4	12	9.09	84.2	11000	5000	East Channel
10-23			26.8	12	9.17	84.9	33000	2300	
24			27.4	11.5	9.55	87.2	10900	2200	
25			27.7	10.5	9.80	87.5	4600	1700	
26			26.1	10.5	9.92	88.6	3300	1300	
27			25.2	10	10.43	92.3	4600	1300	
28			28.0	-	-	-	-	-	
29			49.8	11	10.19	91.8	13000	4900	
30			53.0	11	10.28	92.6	7900	2300	
31									
10-23	#10 C	489.0	28.4	12	9.07	84.0	17000	5000	Center Channel
24			26.8	12	9.03	83.6	7000	800	
25			27.4	11.5	9.50	86.7	4900	2300	
26			27.7	10	9.71	85.9	17200	2300	
27			26.1	10.5	9.83	87.8	24000	3300	
28			25.2	10	10.39	91.9	2300	1300	
29			28.0	-	-	-	-	-	
30			49.8	11	10.20	91.9	17200	4900	
31			53.0	11	10.02	90.3	14100	6300	

APPENDIX B (CONTINUED)

Tabulation of

Stream Flows and Laboratory Data

Date	Station Number	Stream Mile	River Disch. cfs	Water Temp. °C	Dissolved Oxygen ppm	Percent D.O. satur.	MPN per 100 ml	E. Coli per 100 ml	Remarks
1961			x1000						
10-23	#10 R	489.0	28.4	11.5	8.66	79.1	17000	2000	West Channel
24			26.8	12	8.80	81.5	24000	2200	
25			27.4	11.5	9.44	86.2	13000	2300	
26			27.7	10	9.51	84.1	13000	2300	
27			26.1	10.5	9.50	84.8	10900	1300	
28			25.2	10	10.39	91.9	7000	500	
29			28.0	-	-	-	-	-	
30			49.8	11	9.97	89.8	3100	2300	
31			53.0	11.5	9.74	88.9	130000	7000	
Section Mean Values									

APPENDIX B (CONTINUED)

Tabulation
of
Stream Flows and Laboratory Data

Date	Station Number	Stream Mile	River Disch. cfs	Water Temp. °C	Dissolved Oxygen ppm	Percent D.O. satur.	MPN per 100 ml	E. Coli per 100 ml	Remarks
Mississippi River									
1961			x1000						
10-23	#12	486.0 ⁺	28.4				33000	5000	Moline
24			26.8				49000	8000	WaterWorks
25			27.4				33000	7000	Intake
26			27.7				70000	11000	
27			26.1				49000	22000	
28			25.2				33000	8000	
29			28.0				33000	5000	
30			49.8				130000	49000	
31			53.0				17000	5000	
	Oct. 23-29 mean						38100	9400	
	Oct. 23-31 mean						51800	13300	
10-23	#13	484.5	28.4				33000	2000	Davenport
24			26.8				13000	5000	Water Company
25			27.4				7900	4900	Intake
26			27.7				17200	2300	
27			26.1				13000	3300	
28			25.2				33000	3300	
29			28.0				79000	7000	
30			49.8				22100	7900	
31			53.0				46000	7900	
	Oct. 23-29 mean						28000	3970	
	Oct. 23-31 mean						33000	4800	

APPENDIX B (CONTINUED)

Tabulation
of
Stream Flows and Laboratory Data

Date	Station Number	Stream Mile	River Disch. cfs	Water Temp. °C	Dissolved Oxygen ppm	Percent D.O. satur.	MPN per 100 ml	E.Coli per 100 ml	Remarks
Mississippi River									
1961									
10-23	#14 L	483.5	28.4	12	9.01	83.4	6000	4000	East Channel
24			26.8	12	8.90	82.4	7900	1300	
25			27.4	12	9.29	86.0	3300	3300	
26			27.7	10	9.69	85.7	14100	1100	
27			26.1	10.5	9.60	85.7	7900	3300	
28			25.2	10	10.10	89.4	3300	500	
29			28.0	10	10.27	90.9	4900	1300	
30			49.8	10.5	10.10	90.2	7000	3300	
31			53.0	11	10.09	90.2	4600	2300	
10-23	#14 C	483.5	28.4	12	9.10	84.3	13000	2000	Center Channel
24			26.8	12	8.99	83.2	7900	3300	
25			27.4	12	9.15	84.7	4900	1100	
26			27.7	11	9.72	90.0	4900	1700	
27			26.1	10.5	9.58	85.5	13000	3300	
28			25.2	10	10.13	89.6	9400	1100	
29			28.0	10	10.37	91.8	13000	4900	
30			49.8	11	10.08	90.8	49000	10900	
31			53.0	11.5	10.01	91.4	17200	3100	

APPENDIX C

Tabulation of Sampling Stations

<u>Station Number</u>	<u>Stream Mile</u>	<u>Remarks</u>
1	521.6	Mississippi River about 1.3 miles above Fulton Highway Bridge.
2	(opposite) 517.5	Head of Beaver Slough, about 100 yards below effluence from Mississippi.
3	---	Beaver Slough, 1-1/4 miles below (2), at upstream end of Clinton Corn Products property.
4	---	Beaver Slough 1.4 miles below (3), and just below confluence with Mill Creek.
5	(opposite) 512.8	Beaver Slough, about 100 yards above mouth.
6	512.5	Mississippi River just above Camanche.
7	507.1	Mississippi River just above confluence with Wapsipinicon River.
7-a	---	Wapsipinicon River at Iowa State Highway 67, about 2-1/2 miles from mouth.
8	501.0	Mississippi River one mile below Princeton, Iowa gage.

APPENDIX C (CONTINUED)

Tabulation of Sampling Stations

<u>Station Number</u>	<u>Stream Mile</u>	<u>Remarks</u>
9	492.5	Mississippi River at confluence with Spencer Creek, 3/4 mile below Dam No. 14.
10	489.0	Mississippi River, 1/2 mile downstream from south and Winnebago Island.
11	488.5	Intake, East Moline Waterworks.
12	(opposite) 486.0	Intake, Moline Waterworks, near head of Sylvan Slough.
13	484.5	Intake, Davenport Water Co.
14	483.5	Mississippi River at International Milling Company, Davenport.
15	483.0	Intake, Rock Island Waterworks just above Dam No. 15.